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The Maneuver Support Testbed (MSTB) Delivery Order (DO) was conducted under the Site Activation Process described in the Systems Engineering Management Plan (SEMP) and Delivery Order Management Process section of the ADST II Operational Description Plan. This site activation effort was for the Fort Leonard Wood, MO, MSTB facility. The technical period of performance was from March 27, 1997 to September 30, 1997. The effort was performed as DO #0039 under the Lockheed Martin Advanced Distributed Simulation Technology II (ADST II) Contract administered by the U.S. Army Simulation, Training, and Instrumentation Command (STRICOM).

This Final Report includes a description of the effort, its conditions and conduct, and lessons learned. This report addresses the systems capabilities, the associated applications on the systems, and the integration of Government Furnished software models.

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EXECUTIVE SUMMARY

The Maneuver Support Testbed (MSTB) Delivery Order (DO) was conducted under the Site Activation Process described in the Systems Engineering Management Plan (SEMP) and Delivery Order Management Process section of the ADST II Operational Description Plan. This site activation effort was for the Fort Leonard Wood, MO, MSTB facility. The technical period of performance was from March 27, 1997 to September 30, 1997. The effort was performed as DO #0039 under the Lockheed Martin Advanced Distributed Simulation Technology II (ADST II) Contract administered by the U.S. Army Simulation, Training, and Instrumentation Command (STRICOM).

A DO was awarded under the ADST contract in September 1995 for the Engineering Battle Testbed (EBTB). The EBTB DO was set up in three distinct phases; definition and design of EBTB, implementation of the EBTB, and sustainment of the EBTB. At the conclusion of the ADST contract, a subset of phase two objectives were accomplished.

In October 1996 the EBTB was expanded to become the MSTB. The MSTB will be used primarily to support the U.S. Army Engineer School (USAES), the U.S. Army Military Police School (USAMPS), and the U. S. Army Chemical School (USACS). The USAES is currently located at Fort Leonard Wood, MO. The USAMPS and the USACS are currently located at Fort McClellan, AL and will be relocated to Fort Leonard Wood, MO by October 1999. The MSTB is currently located within the USAES. Initially, capabilities of the EBTB are being expanded to establish the infrastructure for the MSTB. In the near term, these capabilities will be generic in nature, to obtain an operational capability. As each school starts to require specialized support from the MSTB, capabilities will be increased to accommodate the support required. Since USAES is currently located at Fort Leonard Wood, it is anticipated that most of the support provided by the MSTB will be for the Maneuver Support Battle Laboratory (MSBL), the Directorate of Combat Developments (DCD), and the TRADOC Systems Manager for Engineer Combat Systems in the near future. As the USAMPS and USACS begin to relocate to Fort Leonard Wood, the MSTB will expand and plan for support of both of these communities. The MSBL will be responsible for scheduling of MSTB assets.

STRICOM was tasked in October 1996 to conduct a Feasibility Analysis Study (FAS). The purpose of the FAS was to update the original EBTB requirements, expanding to allow for MSTB requirements. As the FAS developed into a proposal and contract, the objectives of this effort were:

1) To upgrade the Distributive Interactive Simulation (DIS) capability at the MSTB.

2) To implement the results of the MSTB FAS, dated January 8, 1997.

The approach to the execution of this DO started with the procurement of hardware recommended by the FAS, and an integration period from June 16 through June 27 at the Operational Support Facility (OSF) in Orlando, FL. During this initial integration period the hardware was loaded with the most current ADST II baseline software that will allow the execution of experiments in a Core DIS facility. Once the hardware and software were

configured and tested on the network at the OSF, the equipment was shipped to the MSTB for an additional two week integration effort. The on-site integration effort at the MSTB was between July 21 and August 1. The MSTB integration effort involved the installation and checkout of equipment, testing the equipment on the MSTB network, and training for the on-site personnel.

This Final Report includes a description of the effort, its conditions and conduct, and lessons learned. This report addresses the systems capabilities, the associated applications on the systems, and the integration of Government Furnished software models.

1. INTRODUCTION

1.1 Purpose

The purpose of this final report is to document the ADST II effort which supported the site activation effort for the MSTB. This report includes a full description of the integration effort, its conditions, and lessons learned.

1.2 Contract Overview

MSTB was performed as DO #0039 under the Lockheed Martin Corporation (LMC) ADST II contract with STRICOM. The contract required LMC to participate with STRICOM in a Feasibility Analysis Study (FAS) to determine the best technical approach to update the original EBTB requirements established in 1995. The purpose of the update of the 1995 requirements was to expand the capability to meet the new MSTB requirements as established in 1996. This expansion would allow for the capability for future expansion into a Core DIS facility. The FAS was completed in December 1996. A FAS Report and a Statement of Work were published in January 1997. Contract award was March 31, 1997. LMC procured the required equipment, and had an integration period at the OSF from June 16 to June 27, 1997. Following integration at the OSF the equipment was shipped to Fort Leonard Wood, MO and integrated on-site from July 21 to August 1, 1997.

1.3 Technical Overview

The technical approach to the MSTB effort involved the conduct of the participation in the FAS, and the procurement of equipment recommended by the FAS. Following the procurement of equipment and an initial integration phase at the OSF, the equipment was shipped to the MSTB for final integration. The following is a short synopsis of the technical integration effort for the experiment.

The initial integration effort at the OSF ensured the proper operation of equipment prior to shipping it to the MSTB for installation and final integration. Upon receipt of the equipment at the OSF, field engineers configured the equipment, installed software, and tested the systems in both a stand alone and network configuration. Additional baseline software was obtained from the ADST II Configuration Management (CM) library which would provide the MSTB the capability to conduct, and participate in experiments in the ADST II program. Following the OSF integration phase the equipment was shipped to the MSTB where it was installed, checked out and tested on the MSTB network. This on-site effort took 10 days. The effort included a capabilities demonstration, and training of on-site personnel.

2. Applicable Documents

2.1 Government

-ADST II Work Statement for Maneuver Support Testbed (MSTB), January 30, 1997, AMSTI-97-WO01

-Feasibility Analysis Study (FAS) for Maneuver Support Testbed (MSTB), February 19, 1997, Version 2.0

2.2 Non-Government

-ADST II Technical Approach for Maneuver Support Testbed (MSTB), February 28, 1997, ADST II-TAPP-MSTB-9700084A

3. MSTB Site Description

3.1 Site Configuration and Layout

The MSTB contains a variety of platforms and applications. These platforms and applications provide the MSTB with the following capabilities; Semi-Automated Forces (SAF), displays for monitoring the battlefield, utilities to facilitate exercises, automated data collection capabilities, and data reduction and analysis subsystems. The MSTB support platforms are depicted in Figure 1.

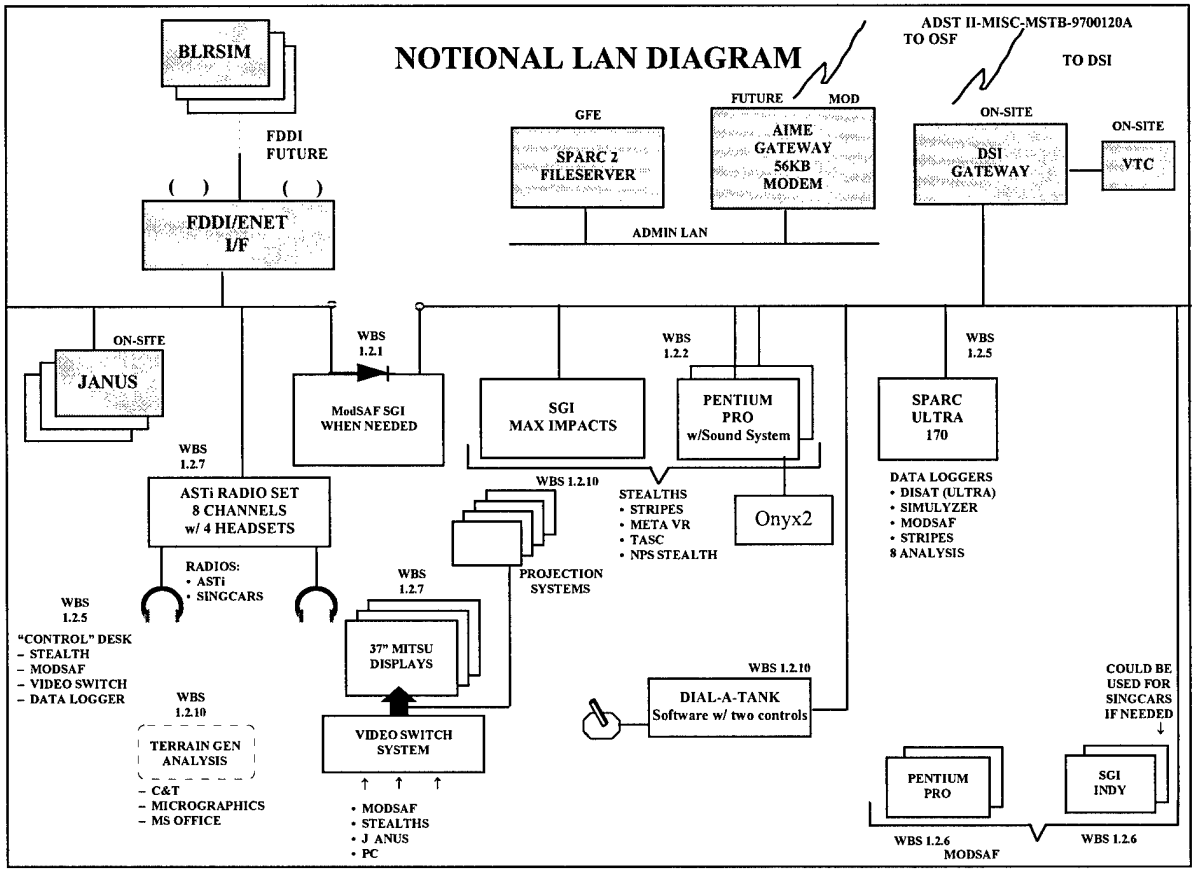

Figure 1 Asset Layout at MSTB

The table below identifies the system configurations delivered to the MSTB.

WBS	*System*	*Description*
1.2.2	SGI Max Impact	Stealth
1.2.2	Onyx 2	Stealth
1.2.2	Pentium Pro 2000	Stealth
1.2.5	Sparc Ultra 70	Data Collection
1.2.5	RS1 License	Data Collection
1.2.6	Pentium Pro	ModSAF
1.2.6	SGI Indy	ModSAF
1.2.7	ASTi PC System	Radio Simulators
1.2.10	Borland C++ Compiler	Misc HW/SW
1.2.10	Dial A Tank SW	Misc HW/SW
1.2.10	Microsoft Office Suite	Site license
1.2.10	Micrographix	Publishing tool

Table 1. System Configurations Delivered to the MSTB

3.2 Description of Components

This section discusses the description, functionality and operation of the system components installed under this effort. This description also describes the GFE models and their integration with the hardware at the MSTB.

3.2.1 Cell Interface Unit (CIU)/Protocol Translator Cell Adapter Unit (XCIAU)

The XCIAU application software provides a bridge between two networks and allows control of the PDU being transmitted to each network by providing PDU filtering capabilities. This protocol translator translates messages between a DIS 2.0.3 compliant and SIMNET 6.6.1 compliant network.

3.2.2 Stealth System

The ADST II Stealth gives the Observer/Controller (O/C) personnel a "window" into the virtual battlefield allowing them to make covert observations of the action occurring during the scenario. In addition, through the use of the data logger, the Stealth gives observers and analysts an After Action Review (AAR) capability. The Stealth is a visual display platform that consists of a Plan View Display (PVD), various input devices, and three video displays that provide the operator with a panoramic, 3D view of the battlefield.

The Stealth permits the controller to fly around the virtual battlefield and view the simulation without interfering with the action. The features of the Stealth allow the observer to survey the virtual battlefield from a variety of different perspectives, including:

a. Tethered View - Allows the user to attach unnoticed to any vehicle on the virtual battlefield.

b. Mimic View - Places the user in any vehicle on the virtual battlefield and provides the same view as the vehicle commander.

c. Orbit View - Allows the operator to remain attached to any vehicle on the virtual battlefield and to rotate 360° about that vehicle, while still maintaining the vehicle as a center point of view.

d. Free Fly Mode - Permits independent 3-D movement anywhere in the virtual battlefield.

Stealth applications provided to the MSTB are:

a. MetaVR Stealth on the MetaVR personal computers, LMC Tag # 02491/02493.

b. TASC Stealth on the SGI MAX Impact, LMC Tag # 02485.

c. Stripes 3D Viewer on the Onyx 2, LMC Tag # 02495.

d. MAK Stealth on the SGI MAX Impact, LMC Tag # 02485.

3.2.3 Plan View Display (PVD)

The PVD provides a high resolution and real-time display of data packets received from all vehicles on the network. A color map display shows the current situation in an exercise by displaying the current positions of all entities involved in the exercise. The PVD also allows the user to view the entire database or zoom to a particular location and view a single vehicle. The PVD also allows the user to work with numerous map tools which enables the user to

use terrain definition options, make intervisibility checks, and use overlay functions. The PVD can also connect to the data logger for remote control of exercise playback.

3.2.4 Command and Control Desktop

Furniture has been ordered to provide desktop control of exercises for the simulation center. This control center is configured with space for monitors on top of the desk and room for three personnel to control and execute exercises.

3.2.5 Data Collection

The Data Logger captures the DIS network traffic and places the data packets on a disk or tape file. The Data Logger performs the following functions:

a. Packet Recording - Receives packets from the DIS network, time stamps and then writes to a disk or tape.

b. Packet Playback - Packets from a recorded exercise can be transmitted in real time or faster than real time. The Data Logger can also suspend playback (freeze time) and skip backward or forward to a designated point in time. The logger can be controlled directly from the keyboard or remotely from the Plan View Display (PVD). Playback is visible to any device on the network (PVD, Stealth Vehicle, a vehicle simulator, etc.).

c. Copying or Converting - Files are copied to another file, which can be on the same or a different medium; and files from the older version of the Data Logger can be converted to a format compatible with the current version of the Data Logger.

Data collection applications provided to the MSTB are:

a. Simulyzer on the SGI Impact, LMC Tag # 02485.

b. DISAT on the Sun Sparc Ultra 170, LMC Tag # 02495.

c. VVAT on the Sun Sparc Ultra 170, LMC Tag # 02495.

d. STRIPES on the Onyx 2, LMC Tag # 02495 and SGI Indy LMC Tag # 02526.

3.2.6 Modular Semi-Automated Forces (ModSAF)

ModSAF is a constructive simulation system which has the capability of populating the Synthetic Battlespace with computer-generated DIS forces for large scale multi-service exercises. ModSAF can be used as both friendly and enemy forces as both single entities or large units. ModSAF is controlled by an operator exercising supervisory control and can perform opposing, flanking, subordinate, and supporting force roles. The operator controls his forces by the use of Operations Orders and Fragmentary Orders that augment the built-in automated reactions of the ModSAF forces. ModSAF 3.0 was installed. This application was installed on three platforms, SGI Indy, LMC Tag # 02527, and both Linux machines, LMC Tag # 02482/02483.

3.2.7 Radio Simulators

The MSTB has two types of radio simulation to meet their requirements. The SINCGARS application was provided as GFE from the ADST II CM Library to enable them to communicate with previously established SINCGARS systems. The other simulation provided was the ASTi PC based system which provides the capability to emulate eight DIS radios. SINCGARS version 4.0 was installed for this effort on a SGI with LMC Tag # 02527 and the ASTi application came on the ASTi personal computer, LMC Tag # 02489.

3.2.8 Network Extension

The network extension improvements were a phased effort. The network is configured to pass both classified and unclassified data. The initial effort was provided under other ADST funding. This work was performed by MWTB personnel from Fort Knox. This work consisted of establishing the configuration of the MSTB network and patch panel rack. Following the initial network extension effort, the MSTB DO procured additional hardware. The labor to install this additional hardware was performed by on-site personnel from the MSTB. MSTB personnel installed the cable and eight additional wall sockets and faceplates.

3.2.9 Miscellaneous Equipment

In addition to the items described in the previous paragraphs, several items of miscellaneous equipment were procured to enhance the capabilities of the MSTB and the Engineer School. Four projectors, software compilers, 37 inch monitors, and the Dial-A-Tank simulation with controls were procured to provide the following capabilities:

- A projection capability was provided to the MSTB Simulation Center to be used as an AAR tool.

- An additional projection capability with three projectors was provided to the Tactical Training Center (TTC) which would allow the Engineer Officer Advanced Course (EOAC) to run simulation exercises and to allow for an additional VTC capability for large audiences.

- The 37 inch monitors provide a Plan View Display capability for the simulation applications. With the Onyx 2 you may use up to three view points for a 180 degree view of the battlefield. With the Stealth applications you have the flexibility to use two view points, and then use the third view point as an additional tool for ModSAF or data collection.

4. Conduct of The Experiment/Effort

4.1 OSF Integration

The integration effort was part of the ADST II Systems Engineering Process. The Systems Engineering Integration Team (SEIT) participated in an Engineering Review Board for all technical materials generated, and all site configuration decisions. This process started early

in the design and development phase and also used the Concurrent Engineering Approach with STRICOM engineers participating.

The OSF integration period was a 10 day effort from June 16-27. The purpose of this effort was to ensure the proper operation of equipment prior to shipping it to the MSTB for installation and final integration. During this phase field engineers configured the hardware, installed the software, and tested the systems in both a stand alone and network configuration. Software applications from the ADST II CM Library were installed on the equipment, and all new hardware and software was brought under CM control. After installation of the software was complete, backup tapes were made and provided to the MSTB for use in case of emergency situations. Appendix A lists all items brought under CM control with copies furnished to the MSTB.

The following items from CM were used:

WBS	SW Item	Version	Purpose
1.2.1	XCIAU	4.1	Network filtering and protocol translation
1.2.2	TASC Stealth	1.0	3D Viewer
1.2.2	STRIPES 3D Viewer	4.1	3D Viewer
1.2.5	STRIPES Datalogger	4.1	Data Collection
1.2.5	Simulyzer	1.5	Data Analysis
1.2.5	DISAT	1.0	Data Analysis
1.2.5	VVAT	6.0	Data Analysis
1.2.6	ModSAF	3.0	Computer Generated Forces, Plan View Display, and Datalogger
1.2.7	SINCGARS Radio Model (SRM)	4.0	DIS Radio Simulation

Table 2. ADST Software Items for MSTB

4.2 On-Site Integration

The on-site integration phase was ten days and took place from July 21 to August 1. During this phase all hardware was configured at the MSTB site, all hardware and software was tested in both a stand alone and network configuration, and training was provided to on-site personnel. The purpose of the training was to allow MSTB personnel to become familiar with the power up and power down requirements, how to use the applications, how to change applications, and mix and match applications. Discussions were also held with the MWTB, AVTB, and OSF integration team, and site personnel on activities that normally take place during daily operations. These discussions oriented on the setting up and execution of exercises and experiments.

During this phase a decision was made by both the integration team and MSTB personnel to not proceed with the original plan of wiring a three channel video capability from the third floor MSTB location downstairs to the first floor TTC. After a review of the requirements it was determined by both building facilities and security personnel that the original estimate of 150 feet for each of the three separate cables was not accurate. It was discovered that the effort would require the penetration of several fire walls, security walls, and building structure supports. An inspection revealed that the new requirement would require three separate cables in excess of 700 feet each. The requirement to provide a simulation capability to the TTC was determined to be only two or three times per year. With this in

mind, it seemed more practical to move two or three platforms from the MSTB to the TTC on as a needed basis and not proceed with a massive construction effort.

4.3 Experiment/Trial Runs

During the on-site integration and training, experimental trial runs were completed with ModSAF and Data Collection applications to allow the MSTB personnel to practice the skills they learned in training. This was followed with additional experiments with the radio simulations and Dial-A-Tank. A demonstration was also provided to Colonel Mc Coy, Director of the Engineering Battle Lab, to show the capabilities of the systems and associated applications.

5. Follow-on Support

Throughout the program, the customer was constrained by budget and not technical capabilities of the contract. Several decisions were made by the customer to reduce hardware items recommended by the FAS in order to get to the target cost. After the Bill of Materials was reduced to meet the target cost, the proposal cost ended up at approximately $40K under the initial budget. At that time the decision was made by STRICOM to put all excess funds from the initial proposal price, plus all additional funds saved over the life of the program, into a Follow-on Support WBS. Funds from this WBS would be used at the end of the program to procure additional hardware that the customer desired and was initially considered not affordable.

Initially, after contract award, three items were procured against the $40K within this WBS. These items were ordered and on hand for the integration phase of the program. These initial items procured under this WBS were:

- Terrain Visualization Tool
- Onyx 2 Multi Channel Option
- Scan Converter

At the end of the on-site integration effort it was determined that an additional funds were anticipated to be available. At the present time MSTB personnel are working the issue to have additional funds be allocated between additional hardware and an additional week of training for other MSTB staff members. Once the exact amount of funding is known, LMC through the IPT process, will coordinate with STRICOM and MSTB personnel and establish the final requirements.

6. Observations and Lessons Learned

6.1 Development and Integration

None

6.2 Overall

- Observation #1

The furniture initially procured for the desktop control station did not meet the requirements for the MSTB.

- Discussion #1

The MSTB required a command and control console for the simulation center. The requirement was to have one recessed position in the center for a console, and space for additional consoles on the sides. An additional requirement was established to have space for three personnel to sit in the console area to control the simulation center activities. When the furniture arrived it was in the shape of a "U" with room for one person to sit, and the recessed rack for the console was on the left and not in the center. All of the parties involved were expecting the shape to be more in the form of an "A", so as the distance from the top increased, there would be room for additional personnel to sit. It was discovered that the vendor provided the correct items as ordered. However, the confusion was over discussions of pictures of other items viewed during the procurement process against was actually ordered.

- Lesson Learned #1

The selection of hardware and software items is easier to track by attaching specification sheets for the performance requirements of the product. With furniture we need to attach photos of the items to accompany the purchase orders. As mentioned in paragraph 3.2.4, the new Command and Control Desktop, furniture has been ordered, and has not yet arrived. During the second procurement process, the vendor provided photographs which were viewed by both LMC and MSTB personnel for approval prior to placing the order.

- Observation #2

The selection of hardware for the network extension did not match the hardware from the work done under previous ADST funding.

- Discussion #2

The wall sockets and faceplates ordered did not match with what was done under previous efforts. The previous work was done with left over hardware from ADST I projects and no documentation was provided. The new order was done without any research of what was previously done. With minimal effort and coordination between MSTB personnel and the buyer, the order was exchanged and the proper hardware was provided and installed. The new hardware is now documented and is available to benefit future procurement activities.

- Lesson Learned #2

In future delivery orders when work follows a previous effort, every effort must be made to research the previous activities to ensure compatibility of hardware.

7. Conclusion

The Maneuver Support Testbed Delivery Order has completed its initial on-site integration. As the Technical Period of Performance comes to an end, it is apparent that the delivery order accomplished it's objectives; of implementing the recommendations of the Feasibility Study, and enhancing the DIS capability of the site. Throughout the program the IPT process and the rapport with the customer were excellent.

Four items require further attention:

a.) The statement of work instructed LMC to provide one extra set of controls for the Dial-A-Tank. The vendor has been unable to fill this request since mid June. As we continue to attempt to procure the controls, the due date from the vendor continues to be pushed out. We will continue to pursue this effort.

b.) During the ModSAF training we attempted to install the Dynamic Terrain Simulation from the ModSAF tree. This was not part of the initial requirement, but it is a desired capability for the MSTB as they become involved in future experiments. This version of Dynamic Terrain had several anomalies. From our initial research, we believe that the SGI version of ModSAF 3.0 which was installed had Dynamic Terrain 1-B, and version 2-B may be the real requirement. This issue needs additional attention as ModSAF goes through further development.

c.) Through the IPT process we need to determine the exact requirements for additional equipment, and personnel training based on the funding status.

d.) The period of performance needs to be extended to accomplish the additional procurement and training tasks which will be implemented with the excess funding.

Acronym List

AAR	After Action Review
ADST	Advanced Distributed Simulation Technology
BLUFOR	Blue Forces
C2	Command and Control
CDF	Core DIS Facility
CDRL	Contract Data Requirements List
CM	Configuration Management
DCD	Director of Combat Developments
DIS	Distributive Interactive simulation
DO	Delivery Order
BOAC	Engineer Officer Advance Course
EBTB	Engineering Battle Testbed
FAS	Feasibility Analysis Study
GFE	Government Furnished Equipment
H/W	Hardware
LMC	Lockheed Martin Corporation
LMSG	Lockheed Martin Service Group
ModSAF	Modular Semi-Automated Forces
MSBL	Maneuver support Testbed
MSTB	Maneuver Support Test Bed
OCR	Observer Controller
OPFOR	Opposing Forces
OSF	Operational Support Facility
PVD	Plan View Display
RIU	Radio Interface Unit
SAF	Semi-Automated Forces

SEIT	Systems Engineering Integration Team
SEMP	Systems Engineering Management Plan
SINCGARS	Single Channel Ground and Airborne Radio System
SOW	Statement of Work
SRE	SINCGARS Radio Emulator
SRM	SINCGARS Radio Model
STRICOM	(US Army) Simulation Training and Instrumentation Command
TIC	Tactical Training Center
USACS	US Army chemical School
USAES	US Army Engineer School
USAMPS	US Army Military Police School

Appendix A - Configuration Management Inventory

4mm AT tape STOWED Stripes Field Installation, CMS MD0191-3

4mm DAT tape Dial A Tank 1.4.4, CM# CT1676-1

4mm DAT tape Open Scene 0.95, CM# MD0303-1

4mm DAT tape SINCGARS Field Installation (Engineering Release),
CM# MD0203-5

4mm DAT tape DISAT/VVAT, CM# B0141-2

4mm DAT tape DISAT DCA tool RS1 1.0, CM# MD0207-5

4mm DAT tape XCIAU STOWEX Field Installation 4.2.2, CM# MD)184-4

4mm DAT tape ModSAF 3.0 (SGI/Linux), CM# MD0306-5

Appendix B - Key Personnel

ADST II MSTB Team

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